

## POTENTIAL RISKS FROM EXPOSURE TO BERYLLIUM IN MUHLENBERG TOWNSHIP, PENNSYLVANIA

### 1.0 OVERVIEW

The purpose of this Report is to summarize the results of studies conducted to evaluate the risk of beryllium, and to a lesser extent chromium, exposure to residents in Muhlenberg Township, Berks County, Pennsylvania.

Since 1978, ambient air in Muhlenberg Township has been monitored for potential contamination from the activities at the NGK Metals Corporation (NGK) facility. The chemicals of concern are beryllium and chromium, both of which are known to be capable of causing an increased risk of cancer. Ambient air emissions of these chemicals are regulated under the EPA National Emissions Standards for Hazardous Air Pollutants (NESHAP), published in 40 CFR Part 61 and administered by the Pennsylvania Department of Environmental Resources (PADER).

Ambient air emissions data collected at the NGK facility indicate that beryllium and chromium have been released to the air, and may have migrated to the surrounding residential community. As a result, representatives of the NGK Metals Corporation and of the U.S. Environmental Protection Agency (EPA) collected soil samples from the surrounding area and analyzed them for the presence of beryllium and chromium. These sampling results have been compared to normally expected, naturally occurring, levels that would exist without an influence from the operations at NGK Metals Corporation, and to standards provided by the U.S. Agency for Toxic Substances and Disease Registry (ATSDR).

The levels of total chromium found in soil samples ranged from 10.2 to 92.6 parts per million, which is substantially below EPA accepted risk level standards of 390 parts per million for just the hexavalent form (page 10, Figure 1.1); therefore, chromium is not considered to be a contaminant of concern in the soil of the residences sampled.

The range of beryllium identified in the residential soil samples ranged from <0.5 to 6.9 parts per million. These levels of beryllium exceed the Risk-Based Concentrations of 0.15 parts per million (page 8, Figure 1.1); however, both PADER's and the U.S. Geologic Survey's data show that these concentrations of beryllium are consistent with naturally occurring concentrations of beryllium in the area. It should be noted that Risk-Based Concentrations are intended as a tool for screening, do not constitute EPA regulations or guidance, and are not a substitute for a site-specific risk assessment. These background studies have identified levels between <1 and 7 parts per million in local rocks and soil, due to the presence of beryllium as a naturally occurring element. PADER observed a concentration of 10 parts per million. Therefore it is not considered likely that levels of beryllium in soils surrounding the facility could be less than those naturally occurring levels in the area of Reading, Pennsylvania.



The balance of this Report provides more detail on: Reasons For This Study; EPA's Sampling Approach; Laboratory Test Results; and Conclusions From The Study.

## **2.0 REASONS FOR THE STUDY**

The predecessor of NGK Metals Corporation began extracting beryllium from its naturally occurring ore, and producing metal alloys containing beryllium in 1935. Certain operations also required the use of chromium containing compounds. These operations produced a variety of wastes, much of which was disposed of at the site in lagoons and landfills. This practice has subsequently been discontinued. Also, prior to 1988 the U.S. Government maintained open stockpiles of beryllium at the facility, as part of its strategic defense initiative. Unfortunately the human health hazards associated with exposure to beryllium and chromium were not well known at the time.

PADER has been monitoring air quality at the facility since 1978, and have identified the presence of both beryllium and chromium in the air at the facility. In 1979 groundwater monitoring wells were installed at the landfill on the NGK 65-acre-property and both beryllium and chromium were found, and still exist, in the groundwater. In 1980 the facility filed an initial Permit Application (Part A) with EPA to manage hazardous waste storage and treatment at the facility. In 1982 they filed the second portion of the Permit Application (Part B) with PADER and in 1984 with EPA. Then in 1985, the facility withdrew both of their Permit requests to store and treat hazardous wastes at the facility; thus restricting themselves to being only a generator of hazardous wastes, and disposing of them off-site. Accordingly, in 1987, PADER terminated NGK's interim status as a hazardous waste container storage, tank storage, and landfill facility. The container and tank storage areas have received final closure certification; however, the landfill never received hazardous waste and continues to operate under a PADER residual waste permit.

In 1988, USEPA Region III issued a RCRA 3008(h) corrective action order (PAD 044540136), which required that NGK conduct a RCRA Facility Investigation (RFI) to determine the extent of the release of hazardous constituents from the site. In 1993, EPA requested that NGK conduct further investigations, under the basic Order, to evaluate the migration of contaminants from their facility into the residential area.

NGK agreed to conduct sampling off-site at public locations, but objected to having to sample at private residences. EPA elected to conduct the sampling at private residences through the use of a contractor, and to have the laboratory testing of these samples done by EPA's Central Regional Laboratory (CRL).

## **3.0 SAMPLING PLAN APPROACHES**

In accordance with a December 1993 request from EPA, NGK submitted a Soils Sampling Work Plan, which EPA approved, and which specified the collection of twelve soil samples for analysis. Three samples were taken at each of four locations. Three of these locations were downwind (east) of the NGK facility. Specifically they were: Cherokee Ranch Playground; St. Marco Social Club; and Kutztown Road Park. The fourth location was

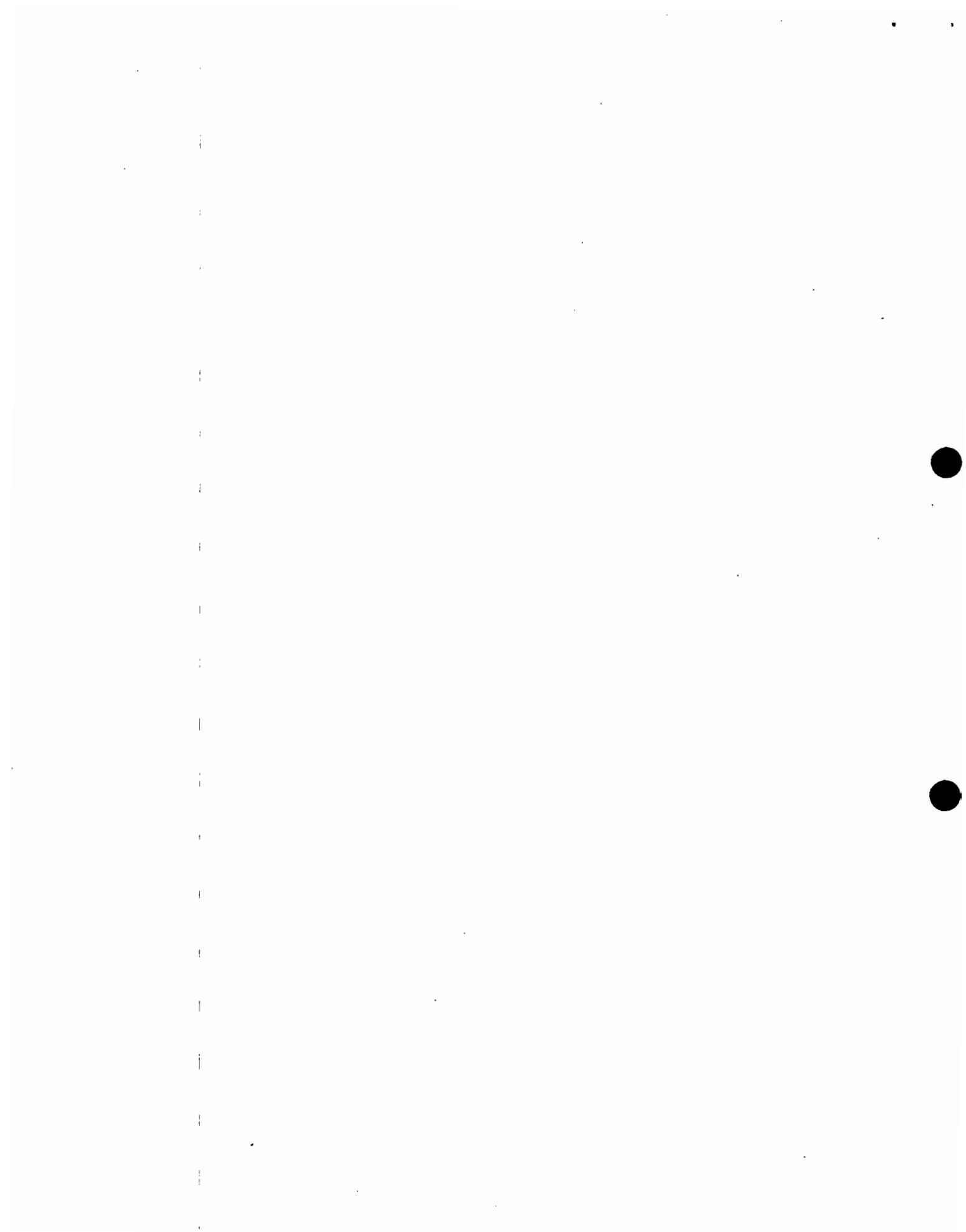


upwind (west) of the facility at the Good Shepherd Church. All samples were taken using a one inch stainless steel auger boring to a depth of six inches (this is considered to be a surface sample). The upwind sample was intended to serve as a background comparison; meaning that if the differences were insignificant, based on a statistical analysis, it would indicate that the facility has not measurably contributed to increased levels of the constituents under study, beryllium and chromium. Figure 3.1 is a U.S. Geological Survey map showing the locations sampled by NGK, and the eight ambient air monitoring locations used in the NESHAP program.

In order to reduce personal bias factors and to support statistical analysis of the final results, for both scientific reasons and from a community relations standpoint, EPA elected to base their sampling locations on a random selection from probable areas that are likely to effect the highest adverse risk. High population risk is caused by the combination of relatively high population density and high constituent concentration. Therefore, two different sample location selection approaches were devised and evaluated. Approach 1 is based on population density and Approach 2 on constituent concentration. Since both the variability of constituent concentrations at each selected location and the relative variability from one location to another are of interest, it was decided to take six samples at each of six locations, plus the appropriate Quality Control samples.

The Population Density approach is based on U.S. Census data, obtained from the Berks County office. This Census data included a map showing five tracts, in the relevant area, and the population for each tract. To determine the relative population density of each tract, a quarter inch transparent grid was laid over an expanded version of the map, and a count was made of the number of squares for each tract. Dividing the given population by the number of grid-squares for each tract provided the following relative population density ranking, in units of population per square: Tract 128 = 94; tract 126 = 60; tract 125 = 28; tract 127 = 24; and tract 124 = 20. Figure 3.2 is a copy of the Census Tract map provided by the County. Since it was deemed desirable not to be confined to just a small portion of the Township, the sampling decision was to select 3 sample locations from tract 128; 2 from tract 126; and 1 from tract 125. The next step was to use a random number generator to select grid coordinates, the center of which would represent the selected location.

The Constituent Density approach is based on using a wind rose to identify the area most likely to be impacted by the fallout of airborne dust, emanating from the facility. The basic wind rose was created from 1989 data obtained from the closest reliable source of meteorological data, Allentown, PA. A copy of this wind rose is shown as Figure 3.3. The length of the vectors on the wind rose represent the percentage of time that the prevailing wind was emanating from the direction shown. Thus, it was reasoned that air born dust would be distributed in proportion to the reverse of the collective wind direction vectors. To establish an area-of-interest for sample selection, the peaks of the vectors were connected graphically to create an area which is expected to have a relatively higher concentration of constituents than the surrounding area, using the center of the wind rose as the NGK Metals Corporation facility. This area-of-interest template was then size adjusted on a photocopy machine to coincide with a two square mile area on a map of the Muhlenberg Township area. Then both the area-of-concern template and a quarter inch grid were superimposed and



photocopied, to produce the site selection map shown as Figure 3.4. Since it was recognized that not all property owners selected would be willing to permit sampling on their property, twenty selections were made using a random number generator. The specific property selected for each grid was the one located at the center of the selected grid square.

After consideration of both sample location selection approaches, it was decided that for the initial study it was more important to identify and measure likely areas of highest contaminant concentration than to select based on simply relative population density. Therefore, the Constituent Density approach was selected. Figure 3.5 lists the twenty locations initially selected. The letter, which is presented as Figure 3.6 was sent to each of these property owners. After allowing a two week response time, and follow up phone calls to insure that candidates had received the letters, only five property owners on this list were willing to participate; however, on the day of sampling one resident elected to change her mind, which reduced the statistically based sample locations to four. Since the initial goal was to sample at six locations, a deviation of the plan was made to select the location nearest where air monitoring had shown the highest level of beryllium; this was the mushroom farm. Fortunately, the owner of this property was willing to participate. The sixth location was selected to provide a background sample, upwind and outside of the designated high Constituent Density area, and was taken at the request of the property owner.

For the six samples to be taken at each location, it was decided that a field judgement would be made to select three samples each from areas judged to be likely concentration areas, such as drain spouts and low areas where contaminants (if present from air born deposits) would be most likely to concentrate. The other three samples would be taken from areas judged to have the most likely human contact, such as play areas and gardens.

All samples were taken on October 25 and 26, 1994. All samples were taken at depths ranging from surface to a maximum of six inches using conventional garden trowels. All sampling equipment was thoroughly decontaminated between each sampling location. Detailed sampling procedures, including quality control and chain of custody protocol, were carried out in strict conformance to the Sampling and Analysis Plan, which was reviewed and approved in advance by EPA Region III's Central Regional Laboratory and the Region. Sampling was performed by an EPA contractor under the direct field supervision of a senior EPA representative. Color photographs were taken at each location where a sample was collected. Also, a field procedures log was created and maps detailing the exact sample locations were prepared. All samples were shipped to and analyzed by EPA's Central Regional Laboratory according to EPA SW-846 procedures.

#### **4.0 LABORATORY TEST RESULTS**

The laboratory test results of the residential soil sampling activities for beryllium and for chromium analysis are shown in Figure 4.1. These results include those taken by both the NGK Metals and EPA contractors. The first four locations presented were taken under NGK direction and the remaining six under EPA direction. The first sample location, the Good Shepherd Church, and residence #3, Stoudt's Ferry Bridge Road, were specifically selected to represent background areas, which by definition, would not be affected by releases from





the NGK Metals Corporation facility. Sample number five, the mushroom farm, was specifically selected as a location most likely to have been effected by releases from NGK Metals. The range of beryllium identified in the residential soil samples is from <0.5 to 6.9 parts per million. Figure 4.2 shows the location of the EPA samples corresponding to the results shown in Figure 4.1. The NGK locations are shown on Figure 3.1

Figure 4.3 is a letter provided by the Commonwealth of Pennsylvania Department of Environmental Resources (PADER), which summarizes the results of their independent study evaluation of expected beryllium concentrations for rocks and surficial deposits in Berks County and the surrounding area. PADER was not asked for similar information on chromium, since the levels found for this chemical were sufficiently low as to not represent a health concern. Figure 4.4 is a table from USGS document, professional paper 1270, Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States, by H.T. Shacklette and J.G. Boerngen.

The basis for determining if the target samples yielded significantly higher levels of beryllium than normal background was to subject the results to statistical analysis. The method selected is the Student T test at the 99th percentile. The 41 target samples from 8 locations were first compared to the 9 samples from 2 locations, and then to the USGS data for Eastern U.S. The conclusion is that concentrations of beryllium at the target resident and public locations are not significantly higher than normal background for the area. The handwritten statistical calculations are provided as Figure 4.5 of the attachments.

## 5.0 CONCLUSIONS

The results of this study indicate that potential releases of beryllium and chromium from the NGK Metals Corporation have not contributed to a significant increase of these chemicals in the Muhlenberg Township area, surrounding the NGK facility. Both the PADER and USGS study results show that normal, naturally occurring, background levels in the Township, Berks County and neighboring counties are higher than national averages. However, the residential soil sampling results, which included target locations and two background locations, indicate that beryllium concentrations in the area are within the expected range for local area rocks and soil, due to the presence of beryllium as a naturally occurring element.

